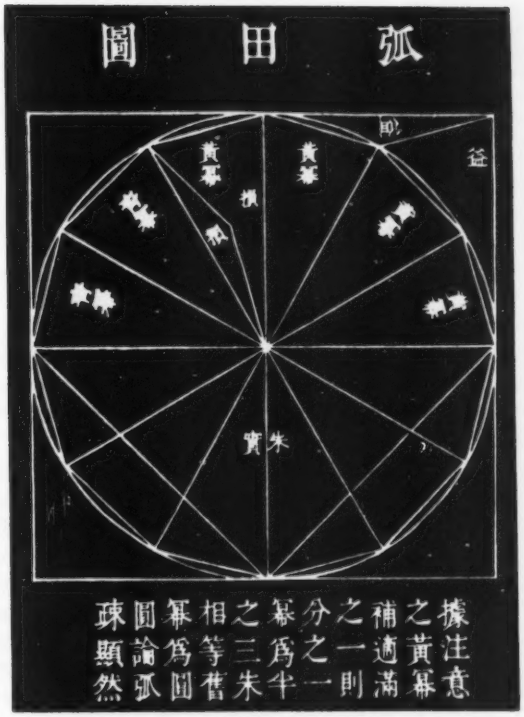
AAAS Bulletin

American Association for the Advancement of Science

March 1961




# Science in Communist China

► Communist China's "march on science" is stumbling on a shortage of highly trained research scientists. This is one of the parameters of Chinese progress in science reported to a symposium on the subject at the last Annual Meeting.

In mathematics, China has perhaps less than 400 researchers with training equivalent to the doctorate. In the natural sciences, not more than 1,200 men at the doctorate level are engaged in full or part-time research. These were estimates made by John M. H. Lindbeck of Harvard's Center for East Asian Studies. Nor, despite some efforts, have the Chinese found it possible to mass-produce Ph.D.'s. Hundreds of students have gone to the Soviet Union for scientific training, but Lindbeck also estimated that not more than a "couple of hundred" students have completed doctorate level training in China itself since establishment of the People's Republic.

Some perspective on how quickly these numbers may change came from J. Tuzo Wilson, a McGill University geophysicist and the only participant in the symposium who had had a chance to visit China since the Communists took over.

Dr. Wilson told of meeting with a group of professors who had planned and put into operation a college for 6,000 students in six years. Over this period the 30 professors "produced only two research papers but laid the ground for tremendous future progress."

Specialists in 25 scientific fields based their reports to the symposium on painstaking analysis of some 200,000 pages of Chinese scientific literature. This massive effort to estimate China's progress in making up a technological lag of four centuries was sponsored by the National Science Foundation, which also arranged for collecting the relevant Chinese scientific literature, largely from federal libraries. NSF staff met with representatives of the AAAS and other scientific societies last April to choose specialists equipped to appraise each field; in many cases, the planners were able to name Chinese-American scientists who needed no translation of the reference documents.

In approximately four months the appraisals will be published in the AAAS *Symposium* series; orders already received for the volume include requests from governments on both sides of the Iron Curtain.

The reports may be the most accurate outline available to the West of the grid of technology that today hums across the ancient "root and garden of all life." China's 3.5 million square mile land mass is now linked by 6,000 miles of new railroads laid across mountains and rivers, by television broadcasting stations, by a facsimile telegraph system (ideal for Chinese ideographs), teleprinters

是 Life . . . stands in the middle of a vast expanse, without visible exit, entrance or shelter.

The living and the dead, the going and the coming, know nothing of each other's state. 非

想 To know that one does not know—that is high wisdom. . . . Those who can think learn for themselves, and not from the Sages.

Heaven and earth are not benevolent. 天

—Taoist Texts

equipped with 4,000 Chinese characters, standard telephone circuit kits manufactured at urban centers and mailed to rural districts for "do-it-yourself" attachment.

With 21,000 geological workers as compared to 200 in 1949, the Chinese have discovered and are exploiting vast mineral deposits; they are already sixth among world steel producers and third in production of coal. Only the U. S., Russia and Canada now have more weather reporting stations than Communist China, and to no other field do the Chinese give higher priority while they plan future protection from the floods and droughts that have for centuries laid waste their agricultural land (over 1,000 major floods are recorded in Chinese history since 206 B. C.). Claiming over 160 million acres of irrigated agricultural land already available, the Chinese are planning a massive system of canals to divert tributaries of the swollen Yangtze to the north and northwest, where 51 per cent of their farm land lies. Multi-discipline teams are studying ways to melt the glacial ice caps and to turn the shifting sands of the desert into arable soil.

#### 90 Kwh per Capita

Although electric power production has increased by 800 per cent since 1952, 1960 production amounted to only 90 kwh per capita as compared to 4,250 kwh in the United States. Even the 100 billion annual kwh which the Chinese expect to produce by damming the fearsome Yangtze will not quite triple the electric power available per capita.

If electric power is one measure of the distance the Chinese have yet to run to catch up, there are others: the atom bomb within not more than five years; physics as a whole in a state comparable to that of the Russians in the 1930's; mathematics "well advanced in its path toward maturity"; first-rate olefin, benzene and acetylene chemistry, with plastics, nylon, all major antibiotics and steroids in production; a "solid foundation established for chemical research." In electrical engineering, said Columbia's T. C. Tsao, China is about 15 years behind the U. S. but on a "high-speed chasing curve."

Not all of China's present food shortage is the result of the natural calamities of 1960, according to a report by Ralph W. Phillips and Leslie T. C. Kuo, both of the Department of Agriculture. There is evidence of bad planning and management: it has been necessary to shift from nationwide use of heavy Russian ploughs; deep ploughing and dense planting are no longer considered a universal solution for boosting output; methods of producing chemical fertilizers in small local plants have proved inefficient. Crop improvement research has to some extent been blocked by Michurin orthodoxy in genetics, and more than one researcher working from Mendelian or Morgan premises has been obliged to throw out his carefully cultivated wheat strains.

China's present tremendous emphasis on applied research centers in the research organizations of the industrial bureaus and of their subordinate industries. University research is now limited chiefly to student training; it is a means of teaching research methods and a resource often used by the industrial bureaus for mobilizing a shock force to undertake a given problem. Basic research is in the hands of the various institutes of the Academy of Sciences, established by the Communists in 1949.

#### Science Must Serve the State

The volume also documents the effort to which the Communists have been put in coping with the well-known inclination of scientists of all nationalities to get on with their work without getting involved in politics. The Chinese scientists were, of course, in particular trouble because they were almost all Western-trained and of bourgeois origin. Moreover, they were the "scholar" class to which for thousands of years China has accorded the prestige and influence historically commanded by the priesthood in many European countries.

China's busy scientists are charged not only with the task of bringing China abreast of the advanced countries of the world by the end of 1967, but also with the duty of spending time in political study and personal thought reform. Nor is study enough; "thought must be translated into action" in various sorts of political activities. There is also the requirement that scientists "now go to the farms and factories . . . to learn from the peasants and workers", while "countrified experts" are occasionally brought in to occupy professorial chairs in such subjects as entomology in the universities.

Fundamental to the Communist Party's long struggle with the scientists is the Party's principle that science must serve the state. The decision on what scientific research meets this requirement is made, not by scientists, but by the Scientific and Technological Commission, headed by a member of the Party's Central Committee. In the U.S.S.R., the scientific community can count some members within the inner circle of political power. This is apparently not true in China, where senior scientists have little or no association with senior party officials and no place on the policy-making Commission.

The National Science Foundation has asked the scientists who participated in the symposium to continue to monitor future progress in Chinese science. This many not be easy; since the end of 1959, the number of Chinese scientific and technical periodicals reaching the U. S. has dropped sharply. The Library of Congress, for example, which formerly received some 150 scientific and technical periodicals from mainland China, got only a few of these in 1960 and none at all so far in 1961. Booksellers in Hong Kong, London, Berlin and Moscow report that they are no longer able to take orders for subscriptions to these journals. *Science Abstracts,* hitherto published by Peking in English, ceased publication in 1959.

The increasing scientific isolation of the Chinese People's Republic is also evident in withdrawal from international scientific associations to which Nationalist China has been admitted. The scientific loss involved is not exclusively China's; particularly in such fields as geophysics, geology, weather study, astronomy and space science, comprehensive studies cannot be made without observations from the great land mass of Red China.

# On the Cover

► While Chinese discovery of the magnetic compass and knowledge of the magnetic properties of the earth before 300 A. D. are well-known to the West and are some indication of the high level of scientific development of early China, few Westerners are aware of the depth and range of early Chinese achievements in mathematics, astronomy, geology and certain other scientific fields. Contemporary Chinese scientists are highly aware of their illustrious roots, and no attempt to understand the present character of Chinese scientific work can neglect the influence of the past.

The drawing on the cover is an illustration from the most famous of all Chinese mathematical works, the *Chiu Chang Suan Shu* or *Nine Chapters on the Mathematical Art,* which for a thousand years helped China's ruling officials solve problems of land measurement and taxation. The drawing is based on a diagram made by Liu Hui about 264 A. D. and sets forth his exhaustion method for finding the value of pi. Liu's method was to draw a polygon within a circle and to calculate the perimeter on the basis of the properties of the right-angled triangles so formed. He reported a value of 3.142704, a little better than Archimedes' famous result, 3.1428.

All this comes from a remarkable book, *Science and Civilization in China* —an indispensable perspective for those who wish to form some impression of the extent to which present currents in Chinese society are likely to endure. This is the work of a Cambridge biochemist, Joseph Needham, the only Westerner to approach the history of China with a knowledge of both science and of the Chinese language, which comprises 40,000 ideographs. Three volumes of seven have so far been published; in these Needham and his research assistant, Wang Ling, trace many of the technical and scientific discoveries which the West took over from China during the first 13 centuries of the Christian era "often without the slightest realization of where they had come from." For example, while Greek mathematics was geometric and abstract, Chinese strength in arithmetic and algebra, Needham says, laid the foundations for the difficult—and difficult because they were elementary and basic—techniques of handling the concrete universe.

Western observers like Amaury de Riencourt have emphasized the compatibility of the rigid social organization of Chinese Communism with thousands of years of Confucianist teaching which molded "Chinese society into an antlike community in which every member appears to be one tiny cell in a gigantic super-organism." Needham, on the other hand, explores a directly opposed and comparably deep influence in the development of Chinese character: Taoist thought, which he calls "proto-scientific."

### Refuge for Individualism

The main lines of Taoist thought survive in 2,000-year-old Taoist texts; the chief of these is the *Tao Te Ching,* believed to have been written by Lao Tzu about the third century B. C.—when Aristotle was old. The few quotations on the page opposite suggest something of the character of Taoism, the "path" which sought not inaction (as Westerners sometimes infer) but action in harmony with nature. Taoism, according to Needham, "amounted to a profession of faith in the natural sciences."

While the Confucianists were so preoccupied with human social life as to ignore non-human phenomena, Taoism represented a refuge for Chinese individualism, for minds impervious to the drive of this crowded society for conformity and centralism and preferring to seek human solutions in observation of the rhythmic pattern of nature.

Another vista opened by Needham on what sort of reacting mixture modern science, the Communist state and the Chinese mind are likely to produce

*Continued on page four*

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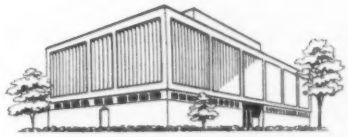

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The American Association for the Advancement of Science, founded in 1848, offers membership both to professional scientists in all fields and to other men and women who have a general interest in science and who recognize its relation to human welfare.

Annual membership dues are $8.50. Each member receives the *Bulletin* and *Science,* the scientific newsweekly established by Thomas A. Edison in 1880. *Science* includes reports of original research across the spectrum of the physical and biological sciences as well as news of scientists and their work.

is his belief that Chinese "associative" or "coordinate" thinking is much better adapted to dealing with the modern field-of-force universe than Western cause-and-effect thinking. From the advent of the Jesuits in Peking, the Chinese habit of associative thought has baffled the West and led to substantial under-rating of Chinese contributions in science. Nor were the Chinese classifiers and categorizers like the West. It is Needham's provocative suggestion that the "coordinative" heritage of the Chinese mind is an essential tool in the organic universe of contemporary science.

## New Publication

► *Improving Science and Mathematics Programs in American Schools,* a report from the Joint Commission on the Education of Teachers of Science and Mathematics, has been published. The Commission was the joint undertaking of AAAS and the American Association of Colleges for Teacher Education.

The report reviews the status of science and mathematics in public elementary and secondary schools, makes brief recommendations for improvement of instruction, describes recruitment and preparation of teachers and makes specific proposals for cooperative action and research to raise standards of teacher preparation. Sample: Can courses to upgrade teachers successfully make use of public school facilities?

## Editors' Review

► Five AAAS Fellows will outline frontiers of science that stretch from the interior of a single living cell to the measureless boundaries of the universe for the American Society of Newspaper Editors at their annual meeting in April.

The day-long science session was arranged by the AAAS at the request of the editors. Alfred Friendly, managing editor of the *Washington Post* and chairman of the ASNE Program Committee, tells us that the plan stems from a small meeting held last year along a Minnesota lake shore and sponsored by Carleton College, the Mayo Foundation, the University of Minnesota, and the *Minneapolis Star and Tribune.*

"The consequence of the meeting," Mr. Friendly says, "was a realization by the newspaper types of the fascination of the new worlds in science, of what terrific copy they are for the daily press, and that this material is as important to cover as the courts, the Congress or the County board—and much more interesting and readable."

Several hundred newspaper editors are expected to attend the day-long session in Washington on April 19. Dr. Harlow Shapley, dean of U. S. astronomers and now visiting India, Pakistan, and Australia, will review some of the new knowledge of the origin and nature of the universe.

One of the pioneers of molecular biology, Dr. Francis O. Schmitt, M.I.T., will tell how chemical physics and quantum chemistry are helping to disclose the energy patterns that add up to behavior, memory and learning.

Science in its ever more complex relation to society will be explored by Dr. Warren Weaver, vice president of the Alfred P. Sloan Foundation. Dr. Weaver, who began his career as a professor of mathematics, brings to his subject the insight of many years of work as an administrator for the Rockefeller Foundation and other public and private agencies concerned with a wider distribution of the benefits amassed by scientific advance.

Dr. Frank Press, director of the seismological laboratory at California Institute of Technology, will outline some of the new findings of geophysical research and some of the problems of detecting underground explosions. Dr. Press has been both a consultant to the President's Advisory Committee for Science and Technology and to our negotiators at Geneva.

Inbuilt timing devices or "biological clocks" are the subject of Dr. Frank A. Brown, Jr., professor of biology at Northwestern University, who has analyzed these rhythmic behavior patterns in plants and animals as diverse as fiddler crabs and potatoes.

## Meetings Ahead

Save a place on your calendar for regional AAAS meetings ahead:

**Southwestern and Rocky Mountain Division**

April 16-20, Tempe, Arizona

**Pacific Division**

June 19-24, University of California, Davis

# Help Wanted—Yours

Volunteer reviewers of *The AAAS Science Book List* are needed. The *List,* first published in 1959, recommends 900 science books as both scientifically accurate and fascinating reading for high school students (see *Bulletin,* January 1961). In a number of states, the *List* has been adopted by departments of education as a guide for book purchases with funds made available by the National Defense Education Act of 1958.

Dr. Hilary J. Deason, under whose direction the *List* was made, expects to revise it next summer and will welcome suggestions from the membership on titles to be added or removed. We shall be glad to mail copies of the *List* to those who may no longer have it at hand.

While the original purpose of the *List* was to find the sort of books that will spark an interest in science among high school readers, many of the books chosen were found to appeal as well to undergraduate college students and to adults who are not specialists in science. This wide interest will be kept in mind in compiling the new list; the objective is to provide a basic nucleus of the best science books for the nonscientist currently available. Coverage of the *List* is limited to the natural sciences and to those social sciences which have their origin in the natural sciences (for example, physical geography but not cultural geography, anthropology but not sociology are included.)

Consider yourself a reader for us over the next months, Dr. Deason asks. If you encounter a book that merits addition to the *List,* send us a postcard giving author, title, publisher and, if possible, year of publication. Let us have the benefit of your judgment in improving a selection of books that has already had wide influence in opening the world of science to readers who are not scientists.

AAAS membership, which began with 461 scientists just 113 years ago, stood at an all-time high of 62,097 at the end of 1960. This represents a net gain for the year of 2,805 new members and a larger gain than that of any year except 1957 (net gain, 3,009) and the special centennial campaign years of 1947-48 (net gain, 13,690 for the two years.)

The membership has tripled over the last 20 years. Biological and medical scientists constitute the largest group of AAAS members (26,034), chemists are next (10,768), followed by physicists (6,070).

A major source of new memberships are letters of invitation sent to members of our affiliated professional societies, always with the approval of the boards of these societies. In 1956, for example, letters to members of the American Chemical Society brought in over 2,000 chemists as new AAAS members. This year some 85,000 members of the American Medical Association not now belonging to the AAAS will be invited to join us.

Often envelopes for such large mailings are addressed through the courtesy of the professional societies. The mailing list of our own members is compiled not only by state and city, but also by zone. This is not usually the case for associations who do not mail weekly news magazines. For this and a number of other small but unmanageable reasons, it would be very expensive to cross-check such special mailing lists against our list of AAAS members. This is the reason why you may have been irritated by receiving an invitation to join the Association to which you have belonged for 25 years. When this happens, reflect on the saving it means in our joint funds, and pass the invitation along to someone else.

Nominations by members have always been an important means of enlarging our membership. Let us have your suggestions of men and women whose ability and energy should be enlisted for AAAS purposes.

# AAAS Fellows

► How does one become a Fellow of the AAAS? What are the requirements? How does a Fellow differ from an ordinary member? Members sometimes ask these questions; here are the answers.

"Any individual member who shall have made a meritorious contribution to science may become a Fellow of the Association under such procedures as the Board of Directors shall have prescribed." This is the constitutional definition. In operation, the basic requirement is a doctor's degree and continued research contributions beyond the doctorate, or the equivalent. There is no fixed time requirement, but a person does not normally become a Fellow until he has proved his worth through five or more years of work beyond the doctorate. Contributions other than pure research are also recognized, and Fellows may be elected on the basis of achievement in teaching, administration, scientific editorial work, or the practical applications of science.

### Nomination by Three Fellows

Fellows are elected by the Board of Directors following nomination by three Fellows. This method was probably intended to be used most frequently but the AAAS itself makes the method a bit difficult, for no membership directory has been published since 1948 to show who is a Fellow and who is not. Nevertheless, the method remains, and is used, principally by some of the geographic divisions and academies of science, which periodically review their own membership and make nominations.

## Section Membership

| | Section | No. of Members |
|---|---|---|
| Medical sciences | N | 15,697 |
| Chemistry | C | 10,768 |
| Zoological sciences | F | 6,070 |
| Physics | B | 4,196 |
| Psychology | I | 3,968 |
| Engineering | M | 3,591 |
| Botanical sciences | G | 2,672 |
| Geology & geography | E | 2,402 |
| Mathematics | A | 1,879 |
| Agriculture | O | 1,570 |
| Education | Q | 1,060 |
| Social and economic sciences | K | 933 |
| Dentistry | Nd | 908 |
| Anthropology | H | 718 |
| Pharmacy | Np | 687 |
| History & philosophy of science | L | 418 |
| Astronomy | D | 416 |
| Industrial science | P | 325 |
| Science in general | | 54 |
| No section | | 1,338 |

Fellows may also be nominated by the section committees, and in practice this is the chief method employed. Annually we send to the secretary of each section a card file of the AAAS members who are affiliated with his section. He reviews the names with the aid of members of his section committee and submits the names of members who should be elevated to fellowship status.

As a third method, the AAAS takes advantage of the fact that a number of affiliated societies have comparable standards for election of Fellows (or a similar class of members with some other name, such as "Senior Members"). AAAS members who are elected to the designated class of membership in an affiliated society are automatically eligible for election as Fellows of the AAAS. Whether or not they are elected depends upon whether they, the affiliated society, or some interested friend inform us of their eligibility. The list of societies and classes of membership that lead to automatic eligibility is printed on the fellowship nomination blank.

### Send Us Your Suggestions

There is a fourth method, one that should not be used very often, but that occasionally is handy: the executive officer may nominate a member for election as a Fellow. Despite the availability of the other methods and the annual screening by section secretaries, once in a while a person of absolutely unquestioned attainments gets overlooked. Several years ago we discovered two Nobel Laureates who had long been members of the Association but who for some reason had never been made Fellows. That oversight was quickly corrected.

Nomination blanks are available on request, and a letter giving biographical details and an account of contributions to science is as good as a formal nomination blank. If you know of members who should be made Fellows, please send their names and credentials to the AAAS office.

***American Association for the Advancement of Science***
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